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Description

The present invention relates to improved nonwoven fabrics made of microfiber webs, characterized by high surface abrasion resistance, and especially suitable for use as medical fabrics.

Background of the Invention

The present invention is directed to nonwoven fabrics and particularly to medical fabrics. The term "medical fabric", as used herein, refers to a fabric which may be used in surgical drapes, surgical gowns, instrument wraps, or the like. Such medical fabrics have certain required properties to insure that they will perform properly for the intended use. These properties include strength, the capability of resisting water or other liquid penetration. often referred to as strike-through resistance. breathability, softness, drape, sterilizability, and bacterial barrier properties.

The use of microfiber webs in applications where barrier properties are desired is known in the prior art. Microfibers are fibers having a diameter of from less than 1 µm to about 10 µm. Microfiber webs are often referred to as melt-blown webs as they are usually made by a melt blowing process. It is generally recognized that the use of relatively small diameter fibers in a fabric structure should allow the achievement of high repellency or filtration properties without undue compromise of breathability. Microfiber web fabrics made heretofore. and intended for use as medical fabrics, have been composites of microfiber webs laminated or otherwise bonded to spunbonded thermoplastic fiber webs, or films, or other reinforcing webs which provide the requisite strength.

Another important property for both nonwoven fabrics and medical fabrics is abrasion resistance. Resistance to surface abrasion effects not only the performance of a fabric but may also effect the aesthetics of a fabric. For example, linting of broken surface fibers is particularly undesirable in medical fabrics. In addition, surface abrasion can affect the strike-through resistance and bacterial barrier properties of a medical fabric. Linting, as well as pilling or clumping of surface fibers is also unacceptable for many wipe applications. An outer layer of a spunbonded fiber web, film or other reinforcing web has been used to develop surface abrasion resistance in melt-blown fiber products.

U.S. Patent 4,041,203 discloses a nonwoven fabric made by combining microfiber webs and spunbonded webs to produce a medical fabric having good drape, breathability, water repellency, and surface abrasion resistance.

U.S. Patent 4,196,245 discloses combinations of melt-blown or microfine fibers with apertured films or with apertured films and spunbonded fabrics. Again, the apertured film and the spunbonded fabric are the components in the finished, nonwoven fabric which provide the strength and surface stability to the fabric.

U.K. Patent Application 2,132,939 discloses a melt-blown fabric laminate suitable as a medical fabric, comprising a melt-blown microfiber web welded at localized points to a nonwoven reinforcing web of discontinuous fibers, such as an air laid or wet laid web of staple fibers.

While the above-mentioned fabrics have the potential to achieve a better balance of repellency and breathability compared to other prior art technologies not using microfibers, the addition of surface reinforcing layers of relatively large diameter fibers limits their advantages. U.S. Patent No. 4,436,780 to Hotchkiss et al. describes a melt-blown wipe with low linting, reduced streaking and improved absorbency, comprising a middle layer of melt-blown fibers and on either side thereof, a spunbond layer.

In order to improve surface abrasion resistance and reduce lint of melt-blown webs generally, it is also known to compact the web to a high degree, or add or increase the level of binder. Copending EP-A-86111123.5 provides a medical fabric from an unreinforced web or webs of microfine fibers. The fabric is unreinforced in that it need not be laminated or bonded to another type of web or film to provide adequate strength to be used in medical applications. The fabric also achieves a balance of repellency, strength, breathability and other aesthetics superior to prior art fabrics. However, as described in the application, in order to render the fabric especially effective for use in applications requiring high abrasion resistance, a small amount of chemical binder may be applied to the surface of the fabric.

U.K. Patent Application 2,104,562 discloses surface heating of a melt-blown fabric to give it an anti-linting finish. It is also generally known to use a level of heat and compaction, e.g., embossing, of a microfiber web to improve abrasion resistance.

The above fabrics which have reinforcing webs have to be assembled using two or more web forming technologies, resulting in increased process complexity and cost. Furthermore, the bonding of relatively conventional fibrous webs to the microfibres, the compaction or the addition of binder to a microfibre web can result in stiff fabrics, especially where high strength is desired.

US Patent 4 165 352 discloses a melt-blown fabric for use as a battery separator. The fabric comprises a core web having an average fibre diameter of 2-10 µm and a surface veneer having an average fibre diameter of 30-40 µm and a basis weight of greater than 25 gm^{-2}.

Brief Summary of the Invention

The present invention provides a melt-blown microfibre embossed web with improved wet and dry surface abrasion resistance of greater than 15 cycles to pill. The abrasion resistance is achieved without the use of additional binder and does not sacrifice the drape or hand of the material.

According to the present invention, there is provided an abrasion resistant melt-blown microfibre fabric comprising a melt-blown microfibre core web and at least one melt-blown surface veneer of fibres having an average diameter in excess of 8 µm, 75% of which have a diameter of at least 7 µm, characterized in that at least one such veneer has a basis weight in the range 3-10 gm^{-2}.

There is also provided a method of producing an abrasion resistant melt-blown microfibre fabric comprising forming a core web of melt-blown microfibres and forming a surface veneer of melt-blown fibres having an average diameter in excess of 8 µm, 75% of which have a diameter of at least 7 µm, characterised in that the veneer has a basis weight in the range 3-10 gm^{-2}.

The surface veneer may be bonded to a melt-blown core web, such as that described in co-pending EP-A-86111123.5 by heat embossing or other methods. The bonding of the veneer to the core web and heat embossing of the core web may be achieved in one processing step. In addition, when the core web and veneer web are produced in one fabric making step using multiple dies, the veneer may be produced atop the core web, with high initial autogenous bonding, eliminating the need to bond the veneer to the core web.

By eliminating the need for additional binder, the present invention provides a method for making melt-blownn microfibre web without the additional processing steps of adding binder and drying and/or curing the binder. Also, potential heat damage during binder curing or drying which may adversely affect the drape and hand of a fabric is eliminated. Stiffening of the fabric through the use of binder solution is also eliminated, thereby permitting adjustment of processing conditions of the core web to maximize other properties.

In addition, the use of a surface veneer of melt-blown fibers provides a fabric with a combination of drape and surface abrasion resistance which cannot be achieved with the addition of binder materials. The use of melt-blown fibers to form the surface veneer also provides economic advantages and minimizes the technologies necessary to produce the fabric.

Thus, the present invention provides an improved melt-blown or microfiber fabric with improved surface abrasion resistance but without binder, which may be used as a medical fabric or wipe or in other applications where high surface abrasion resistance is required. In a preferred embodiment, the fabric of the present invention comprises an unreinforced, melt-blown, microfiber fabric with improved surface abrasion resistance, e.g., greater than 15 cycles to pill, suitable for use as a medical fabric, said fabric having a minimum grab tensile strength to weight ratio greater than 0.8 N per gram per square meter, and a minimum Elmendorf tear strength to weight ratio greater than 0.04 N per gram per square meter. In a most preferred embodiment of the present invention, the embossed unreinforced fabrics described above have a wet abrasion resistance of at least 30 cycles to pill, and a dry abrasion resistance of at least 40 cycles to pill. These properties are achieved while also obtaining the properties of repellency, air permeability and especially drapability that are desired for the use of the fabric in medical applications.

Brief Description of the Drawings

Figure 1 is an isometric view of the melt-blowing process.

Figure 2 is a cross-sectional view of the placement of the die and the placement of the secondary air source.

Figure 3 is a detailed fragmentary view of the extrusion die illustrating negative set back.

Figure 4 is a detailed fragmentary view of the extrusion die illustrating positive set back.

Detailed Description of the Invention

In its broadest aspect, the present invention comprises providing a surface veneer of melt-blown fibers to a melt-blown microfiber web, said surface veneer having an average fiber diameter of greater than 8 µm, in which at least 75% of the fibers have a diameter of at least 7 µm, and having a basis weight in the range

3-10gm^{-2}. For most fabric applications the surface veneer will be laminated to the remainder of web, e.g., by emboss bonding, or combined by other known methods. Thus, the surface veneer may be formed separately from the remainder of the web and thermally bonded thereto, preferably at discrete intermittent bond regions. Alternatively, the veneer may be formed with high initial autogenous bonding atop the remainder of the web eliminating the need to bond the veneer to the remainder of the web, though thermal embossing the fabric may be preferred. The fabrics of the present invention exhibit improved wet and dry surface abrasion resistance and are especially applicable for use as wipes or medical fabrics.

In its broadest aspects, the process of the present invention may be carried out on conventional melt-blowing equipment which has been modified to provide high velocity secondary air, such as that shown in co-pending EP-A-86111123.5, and shown in Figure 1. In the apparatus shown, a thermoplastic resin in the form of pellets or granules, is fed into a hopper 10. The pellets are then introduced into the extruder 11 in which the temperature is controlled through multiple heating zones to raise the temperature of the resin above its melting point. The extruder is driven by a motor 12 which moves the resin through the heating zones of the extruder and into the die 13. The die 13 may also have multiple heating zones.

As shown in Figure 2, the resin passes from the extruder into a heater chamber 29 which is between the upper and lower die plates 30 and 31. The upper and lower die plates are heated by heaters 20 to raise the temperature of die and the resin in the chamber 29 to the desired level. The resin is then forced through a plurality of minute orifices 17 in the face of the die. Conventionally, there are about 12 orifices per centimeter of width of the die.

An inert hot gas, usually air, is forced into the die through lines 14 into gas chamber 19. The heated gas, known as primary air, then flows to gas slots 32 and 33 which are located in either side of the resin orifices 17. The hot gas attenuates the resin into fibers as the resin passes out of the orifices 17. The width of the slot 32 or 33 is referred to as the air gap. The fibers are directed by the hot gas onto a web forming foraminous conveyor or receiver 22 to form a mat or web 26. It is usual to employ a vacuum box 23 attached to a suitable vacuum line 24 to assist in the collection of the fibers. The conveyor 22 is driven around rollers 25 so as to form a web continuously.

The outlets of the orifices 17 and the gas slots 32 and 33 may be in the same plane or may be offset. Fig. 3 shows the orifice 17 terminating inward of the face of the die and the slots 32 and 33. This arrangement is referred to as negative setback. The setback dimension is shown by the space between the arrows in Fig. 3. Positive setback is illustrated in Fig. 4. The outlet of the orifice 17 terminates outward of the face of the die and the slots 32 and 33. The setback dimension is shown by the space between the arrows in Fig. 4. A negative setback is preferred in the present process as it allows greater flexibility in setting the air gap without adversely effecting the quality of the web produced.

The fabrics of the present invention comprise at least one surface veneer and a core web. Preferably, the fabric comprises a core web and surface veneers on both surfaces of the core web. As used herein, veneer means a web of fibers having a basis weight no greater than 50% of the total weight of the fabric. Preferably, the basis weight of the veneer web is about 25% of the weight of the total fabric, and most preferably, between about 15% to 25% of the total weight of the fabric. The veneer web(s) may be formed separately from the core web and then combined therewith in a face-to-face relationship. When using this method, each veneer web must have a basis weight of about 6g/m^2 to facilitate handling of the web to combine it with the core web. Alternatively, the core and veneer webs may be formed atop one another, e.g., by depositing the core web fibers atop the veneer web disposed on the conveyor 22 and acting as the receiver for the fibers of the core web. In this preferred method of the present invention, a veneer web of about 3g/m^2 may be deposited on the conveyor and form the receiver for the core web and/or a veneer web of about 3g/m^2 may be deposited on the core web acting as a receiver. Alternatively, the fiber of the veneer webs may be deposited on both surfaces of the core web in separate web forming steps. Thereafter the core web and veneer web(s) may be laminated, e.g., by heat embossing. When depositing the veneer web(s) on the core web, if the veneer web(s) is formed under conditions which provide high initial interfiber or autogenous bonding, including high die temperature, no secondary air and a short forming distance, (as described more fully below) it may not be necessary to laminate the veneer web(s) to the core as, e.g., by heat embossing, nor to emboss the veneer. The core web may be embossed or unembossed prior to the deposition of the fibers of the veneer web thereon. The embossed fabric laminates of the present invention exhibit a wet surface abrasion resistance of at least 30 cycles to pill and a dry surface abrasion resistance of at least 40 cycles to pill.

As stated hereinbelow, it is possible to form the fabric of the present invention according to the above methods with only one melt-blown die by increasing the polymer throughput and reducing the primary air to form the veneer web(s). In a most preferred method of making the fabrics of the present invention, multiple dies are used.

In its most preferred aspect the present invention comprises an improved unreinforced melt-blown microfiber fabric for use as a medical fabric, said fabric having a minimum grab tensile strength to weight ratio of at least 0.8 N per gram per square meter and a minimum Elmendorf tear strength to weight ratio of at least 0.04 N per gram per square meter. The invention will now be further described in relation to this preferred embodiment.

The requirements for medical grade fabrics are quite demanding. The fabric must have sufficient strength to resist tearing or pulling apart during normal use, for instance, in an operating room environment. This is especially true for fabrics that are to be used for operating room apparel, such as surgical gowns, or scrub suits, or for surgical drapes. One measure of the strength of a nonwoven fabric is the grab tensile strength. The grab tensile strength is generally the load necessary to pull apart or break a 10 cm wide sample of the fabric.

The test for grab tensile strength of nonwoven fabrics is described in ASTM D1117. Nonwoven medical fabrics must also be resistant to tearing. The tearing strength or resistance is generally measured by the Elmendorf Tear Test as described in ASTM D1117. While the grab tensile strengths, measured in the weakest, normally cross machine direction, of the least strong commercially used medical fabrics are in the range of 45 newtons (N) with tear strengths in the weakest direction of approximately 2N, at these strength levels, fabric failure can occur and it is generally desired to achieve higher strength levels. Grab tensile strength levels of approximately 65 N and above and tear resistance levels of approximately 6N and above would allow a particular medical fabric to be used in a wider range of applications. The preferred fabrics of the present invention have a high strength to weight ratio, such that at desirable weights, both grab tensile and tear strengths higher than the above values can be achieved, and generally have basis weights in the range of 14 to 85 g/m^2.

Medical fabrics must also be repellent to fluids including blood, that are commonly encountered in hospital operating rooms. Since these fluids offer a convenient vehicle for microorganisms to be transported from one location to another, repellency is a critical functional attribute of medical fabrics. A measure of repellency that is influenced primarily by the pore structure of a fabric is the "hydrostatic head" test, AATCC 127-1977. The hydrostatic head test measures the pressure, in units of height of a column of water, necessary to penetrate a given sample of fabric. Since the ultimate resistance of a given fabric to liquid penetration is governed by the pore structure of the fabric, the hydrostatic head test is an effective method to assess the inherent repellent attributes of a medical fabric. Nonwoven medical fabrics which do not include impermeable films or microfiber webs generally possess hydrostatic head values between 20 to 30 cm of water. It is generally recognized that these values are not optimum for gowns and drapes, especially for those situations in which the risk of infection is high. Values of 40 cm or greater are desirable. Unfortunately, prior art disposable fabrics which possess high hydrostatic head values are associated with low breathability or relatively low strength. The fabrics of the present invention can attain a a high level of fluid repellency.

The breathability of medical fabrics is also a desirable property. This is especially true if the fabrics are to be used for wearing apparel. The breathability of fabrics is related to both the rate of moisture vapor transmission (MVTR) and air permeability. Since most fibrous webs used for medical fabrics possess reasonably high levels of MVTR, the measurement of air permeability is an appropriate discriminating quantitative test of breathability.

Generally the more open the structure of a fabric, the higher its air permeability. Thus, highly compacted, dense webs with very small pore structures result in fabrics with poor air permeability and are consequently perceived to have poor breathability. An increase in the weight of a given fabric would also decrease its air permeability. A measure of air permeability is the Frazier air porosity test, ASTM D737. Medical garments made of fabrics with Frazier air porosity below 8 cubic meters per minute per square meter of fabric would tend to be uncomfortable when worn for any length of time. The fabrics of the present invention achieve good breathability without sacrifice of repellency or strength.

Medical fabrics must also have good drapability, which may be measured by various methods including the Cusick drape test. In the Cusick drape test, a circular fabric sample is held concentrically between horizontal discs which are smaller than the fabric sample. The fabric is allowed to drape into folds around the lower of the discs. The shadow of the draped sample is projected onto an annular ring of paper of the same size as the unsupported portion of the fabric sample. The outline of the shadow is traced onto the annular ring of paper. The mass of the annular ring of paper is determined. The paper is then cut along the trace of the shadow, and the mass of the inner portion of the ring which represents the shadow is determined. The drape coefficient is the mass of the inner ring divided by the mass of the annular ring times 100. The lower the drape coefficient, the more drapable the fabric. The fabrics of the present invention demonstrate high drapability when measured by this method. Drapability correlates well with

softness and flexibility.

In addition to the above characteristics, medical grade fabrics must have anti-static properties and fire retardancy. The fabrics should also possess good resistance to abrasion, and not shed small fibrous particles, generally referred to as lint.

In addition to the characteristics mentioned above, the preferred fabric of the present invention differs from prior art melt-blown webs in that the average length of the individual fibers in the web is greater than the average length of the fibers in prior art webs. The average fiber length in the core webs is greater than 10 cm, preferably greater than 20 cm and most preferably in the range of 25 to 50 cm. Also, the average diameter of the fibers in the core web should be no greater than 7 µm. The distribution of the fiber diameters Is such that at least 80% of the fibers have a diameter no greater than 7 µm and preferably at least 90% of the fibers have a diameter no greater than 7 µm.

In the description of the present invention the term "web" refers to the unbonded web formed by the melt blowing process. The term "fabric" refers to the web after it is bonded by heat embossing or other means. The preferred fabric of the present invention comprises an unreinforced melt-blown embossed fabric having a core web of average fiber length greater than 10 centimeters and in which at least 80% of the fibers have a diameter of 7 µm or less, and a surface veneer provided on one or both surfaces of the core web, said surface veneers having an average fiber diameter of greater than 8 µm, and in which 75% of the fibers have a fiber diameter of at least 7 µm.

In the process of making this preferred fabric of the present invention, the fibers of the core web are contacted by high velocity secondary air immediately after the fibers exit the die. The fibers of the surface veneer may or may not be contacted by high velocity secondary air. The secondary air is ambient air at room temperature or at outside air temperature. If desired, the secondary air can be chilled. The secondary air is forced under pressure from an appropriate source through feed lines 15 and into distributor 16 located on each side of the die. The distributors are generally as long as the face of the die. The distributors have an angled face 35 with an opening 27 adjacent the die face. The velocity of the secondary air can be controlled by increasing the pressure in feed line 15 or by the use of a baffle 28. The baffle would restrict the size of the opening 27, thereby increasing the velocity of air exiting the distribution box, at constant volume.

The present nonwoven fabric differs from prior art microfiber-containing fabrics in the utilization of the melt-blowing process to produce a surface veneer of fibers with characteristics which differ from the characteristics of the microfibers of the core web and which result in a fabric with high strength to weight ratios, good surface abrasion resistance and drape if the fibers are formed into a core web and surface veneer and thermally bonded as described herein.

In the practice of prior art melt-blown technology for fabric related applications, it is typical to produce microfibers which range in average diameter from about 1 to 10 µm. While in a given web, there may be a range of fiber diameters, it is often necessary to keep the diameters of these fibers low in order to fully exploit the advantages of microfiber structures as good filtration media. Thus, it is usual to produce webs or batts with average fiber diameters of less than 5 µm or at times even less than 2 µm. In such prior art processes, it is also typical for such fibers to be of average lengths between 5 to 10 centimeters (cm). As discussed in the review of the prior art fabrics, the webs formed from such fibers have very low strength and abrasion resistance. The tensile strength and abrasion resistance of such a web is primarily due to the bonding that occurs between fibers as they are deposited on the forming conveyor. Some degree of interfiber surface bonding can occur because in the conventional practice of melt-blown technology, the fibers may be deposited on the forming conveyor in a state in which the fibers are not completely solid. Their semi-molten surfaces can then fuse together at crossover points. This bond formation is sometimes referred to as autogenous bonding. The higher the level of autogenous bonding, the higher the integrity of the web. However, if autogenous bonding of the thermoplastic fibers is excessively high, the webs become stiff, harsh and quite brittle. The strength of such unembossed webs is furthermore not adequate for practical applications such as medical fabrics. Thermal bonding of these webs can generally improve strength and abrasion resistance. However, as discussed in previous sections, without introduction of surface reinforcing elements or binder, it has heretofore not been possible to produce melt-blown microdenier fabrics with high surface abrasion resistance, particularly for use as surgical gowns, scrub apparel and drapes.

In forming the core webs of this preferred fabric of the present invention, fibers are produced which are longer than fibers of the prior art. Fiber lengths were determined using rectangular-shaped wire forms. These forms had span lengths ranging from 5 to 50 cm in 5 cm increments. Strips of double-faced adhesive tape were applied to the wire to provide adhesive sites to collect fibers from the fiber stream. Fiber lengths were determined by first passing each wire form quickly through the fiber stream, perpendicu-

lar to the direction of flow, and at a distance closer to the location of the forming conveyor than to the melt blowing die. Average fiber lengths were then approximated on the basis of the number of individual fibers spanning the wire forms at successive span lengths. If a substantial portion of the fibers are longer than 10 cm, such that the average fiber length is at least greater than 10 cm and preferably greater than 20 cm, the webs, thus formed, can result in embossed fabrics with good strength, while maintaining other desired features of a medical fabric. Fabrics with highly desirable properties are produced when average fiber lengths are in the range of 25 to 50 cm. In order to maintain the potential of microdenier fibers to resist liquid penetration, it is necessary to keep the diameters of the fibers low. In order to develop high repellency, it is necessary for the average diameter of the fibers of the present core web to be no greater than 7 µm. At least 80% of the fibers should have diameters no greater than 7 µm. Preferably, at least 90% of the fibers should have diameters no greater than 7 µm. A narrow distribution of fiber diameters enhances the potential for achieving the unique balance of properties of this invention. While it is possible to produce fabrics with average fiber diameters greater than 7 µm and obtain high strength, the ultimate repellency of such a fabric would be compromised, and it would then not be feasible to produce low weight fabrics with high repellency.

When the melt-blown fibrous core web is formed in such a manner that autogenous bonding is very low and the webs have little or no integrity, the fabrics that result upon thermal embossing these webs are much stronger and possess better aesthetics than fabrics made of webs with high initial strength. That is, the weakest unembossed webs, with fiber dimensions as described above, form the strongest embossed fabrics. The higher the level of initial interfiber bonding, the stiffer and more brittle the resulting fabric, leading to poor grab and tear strengths. As autogenous bonding is reduced, the resulting fabric develops not only good strength but becomes softer and more drapable after thermal embossing. Because of the relatively low levels of web integrity, it is useful to determine the strength of the unembossed web by the strip tensile strength method, which uses a 2.54 cm-wide sample and grip facings which are also a minimum 2.54 cm wide (ASTM D1117). In prior art melt-blown fabrics the machine direction (MD) strip tensile strength of the autogenously bonded web is generally greater than 30% and frequently up to 70% or more of the strip tensile strength of the bonded fabric. That is, the potential contribution of autogenous bonding to the strength of the embossed fabric is quite high. In the fabric of the present invention the autogenous bonding of the core web contributes less than 30%, and preferably less than 10%, of the strip tensile strength of the bonded fabric.

For example, a Nylon 6 melt-blown web with a weight of approximately 50 g/m^2 made under prior art conditions may possess a strip tensile strength in the machine direction of between 10 to 20 N. In this preferred fabric of the invention, it is necessary to keep the strip tensile strength of the unembossed core web below 10 N and preferably below 5 N to achieve the full benefits of the invention. In other words, when long fibers are produced and collected, in such a way that initial interfiber bonding is low, the individual fibers are stronger, and there is greater exploitation of the inherent strength of the fibers themselves.

While it is necessary to produce the fibers of the core web in such a way that initial interfiber bonding is low and 80% of the fibers have a fiber diameter of no more that 7 µm, such webs when embossed do not exhibit high surface abrasion resistance, and a chemical binder is often added to the surface of such fabrics to increase surface abrasion resistance. The addition of binder negatively impacts the drape of the fabric, therefore the amount of binder added must be kept to a minimum, and, in practice, the amount of binder which can be added while maintaining adequate drape gives only satisfactory, but not high, abrasion resistance.

In the fabric of the present invention, the use of binder and its negative impact on drape is avoided by providing the core web with a surface veneer of microfibers on one or both surfaces of the core web. The fibers of the surface veneer have an average fiber diameter of greater than 8 µm and 75% of the fibers have a fiber diameter of at least 7 µm. In addition, in a preferred embodiment, the surface veneer is formed with high initial interfiber bonding.

In summary, this preferred fabric of the present invention, in contrast to conventional melt-blown webs of the prior art, is characterized by a core web of high average fiber length, low interfiber bonding, stronger individual fibers and low fiber diameters in a relatively narrow distribution range to provide high resistance to fluid penetration, and at least one surface veneer of higher fiber diameters and, preferably, high interfiber bonding.

The method of producing the desired core web and surface veneer characteristics of this preferred fabric of the invention is based on the control of the key process variables and their interactions to achieve the desired fiber, web, and fabric properties. These process variables include extrusion temperatures, primary air flow and temperature, secondary air flow, and forming length (distance form die to receiver). The influence of these variables on the key desired web and veneer properties is described below.

For both the core web and surface veneer, individual fiber strength can be enhanced significantly if the die melt temperature, for instance, can be maintained at levels generally 10 to 35 °C below temperatures recommended for prior art processes. Generally, in the present process the die melt temperature is no greater than about 75 °C above the melting point of the polymer.

In forming the core web, the velocity and temperature of the primary air, and the velocity and temperature of the secondary air must be adjusted to achieve optimum fiber strength at zero span length for a given polymer. The high velocity secondary air employed in the present process is instrumental in increasing the time and the distance over which the fibers of the core web are attenuated adding to fiber strength. The use of secondary air in the process of producing the surface veneer fibers is not essential, and secondary air is preferably omitted in forming the preferred surface veneer with high initial interfiber bonding.

The fiber length achievable in the core web and surface veneer is influenced by the primary and secondary air velocities, the level of degradation of the polymer and, of critical importance, air flow uniformity. It is important to maintain a high degree of air and fiber flow uniformity, avoiding large amplitude turbulence, vortices, streaks, and other flow irregularities. Introduction of high velocity secondary air may serve to control the air/fiber stream, by cooling and maintaining molecular orientation of the fibers so that stronger fibers are produced that are more resistant to possible breakage caused by non-uniform air flow.

In order to deposit the fibers of the core web on the forming conveyor as a web with low strip tensile strength, the forming air and forming distance are clearly important. In the present process, the forming distance is generally between 20 and 50 centimeters. First, in order for the core web to have minimal interfiber bonding, the fibers must arrive at the forming conveyor in a relatively solid state, free of surface tackiness. To allow the fibers time to solidify, it is possible to set the forming conveyor or receiver farther away from the die. However, at excessively long distances, i.e., greater than 50 cm., it is difficult to maintain good uniformity of the air/fiber stream and "roping" may occur. Roping is a phenomenon by which individual fibers get entangled with one another in the air stream to form coarse fiber bundles. Excessive roping diminishes the capacity of the resultant fabric to resist fluid penetration, and also leads to poor aesthetic attributes. A primary air flow of high uniformity enhances the opportunity to achieve good fiber attenuation and relatively long distance forming without roping.

The primary air volume is also important factor. Sufficient air volume must be used, at a given polymer flow rate and forming length, to maintain good fiber separation in the air/fiber stream, in order to minimize the extent of roping.

The use of the secondary air system also is important in achieving low interfiber bonding in the core web without roping. As noted previously, the high velocity secondary air is effective in improving the uniformity of the air/fiber stream. Thus, it enhances the potential to increase the forming length without causing undesirable roping. Furthermore, since the secondary air is maintained at ambient temperature, or lower if desired, it can serve also to cool and solidify the fibers in a shorter time, thus obviating the need for detrimentally large forming lengths. For the secondary air system to have an influence on flow uniformity and cooling, and the rate of deceleration of the fibers, its velocity should be high enough that its flow is not completely overwhelmed by the primary air flow. In the present process, a secondary air velocity of 30 m/sec to 200 m/sec or higher is effective in providing the desired air flow characteristics. Obviously, there are various approaches and combinations of primary and secondary air flows, temperatures, and forming lengths that can be used to achieve low interfiber bonding in the unembossed core web. The specific process parameters depend on the polymer being used, the design of the die and its air systems, the production rate, and the desired product properties.

The unembossed core web or layers of unembossed core webs must be bonded to form this preferred fabric of the present invention. It has been determined to be advantageous to use thermal bonding techniques. In a most preferred method of the present invention, the core web or webs are thermally bonded and the veneer thermally bonded and laminated to the core web in one thermal embossing step. Either ultrasonic or mechanical embossing roll systems using heat and pressure may be used. For the present invention, it is preferred to use a mechanical embossing system for point bonding using an engraved roll on one side and a solid smooth roll on the other side of the fabric. In order to avoid "pinholes" in the fabric, it has also been found desirable to set a small gap, of the order of 0.01 to 0.02 mm, between the top and bottom rolls. For the intended use of the fabrics which can be produced by this invention, the total embossed area must be in the range of 5 to 30% of the total fabric surface, and preferably should be in the range of 10-20%. In the examples given to illustrate the invention, the embossed area is 18%. The embossing pattern is 0.76 mm x 0.76 mm diamond pattern with 31 diamonds per square centimeter of roll surface. The particular embossing pattern employed is not critical and any pattern bonding between 5 and 30% of the fabric surface may be used.

The principles of this invention apply to any of the commercially available resins, such as polypropylene, polyethylene, polyamides, polyester or any polymer or polymer blends capable of being melt-blown. It has been found particularly advantageous to use polyamides, and particularly Nylon 6 (polycaprolactam), in order to obtain superior aesthetics, low susceptibility to degradation due to cobalt irradiation, excellent balance of properties, and overall ease of processing.

As stated previously, the preferred fabrics of the present invention have a basis weight of from 14 to 85 grams per square meter. The surface veneers when separately formed, have a basis weight of from about 6 grams per square meter, and when co-formed, a basis weight of from about 3 grams per square meter. Basis weights of the surface veneers are generally no greater than 10 to 15 grams per square meter, as higher veneer base weights may require lower core web basis weights to achieve the desired overall basis weight of the fabric. The fabrics have a minimum grab tensile strength to weight ratio greater than 0.8 N per gram per square meter, a minimum Elmendorf tear strength to weight ratio greater than 0.04 N per gram per square meter and wet and dry surface abrasion resistance of greater than 15 cycles to pill. For disposable medical fabrics where high strength and abrasion resistance are required, the preferred fabrics have basis weights no greater than 60 grams per square meter, a minimum grab tensile strength of not less than 65 N, a minimum Elmendorf tear strength not less than 6 N, and dry surface abrasion resistance of at least 40 cycles to pill and a wet surface abrasion resistance of at least 30 cycles to pill.

It is to be understood that the fibers, webs or fabrics produced according to this invention can be combined in various ways, and with other fibers, webs, or fabrics possessing different characteristics to form products with specifically tailored properties.

The examples which follow are intended to clarify further the present invention, and are in no way intended to serve as the limits of the content or scope of this invention.

Example 1

In the following example, webs 1, 2 and 3 were produced under the conditions set forth in Table I below.

TABLE I

PROCESS CONDITIONS USED TO PRODUCE MELT-BLOWN NYLON WEBS			
Process Conditions	Webs		
	1	2	3
Extruder Temperature - Feed °C	260	232	260
Extruder Temperature - Exit °C	275	275	300
Screen/Mixer Temperature °C	275	275	287
Die Temperature °C	287	265	300
Primary Air Temperature °C	287	287	335
Primary Air Velocity m/sec	290	255	221
Polymer Rate g/min-hole^{-1}	0.14	0.14	0.28
Die Air Gap mm	1.14	1.14	1.14
Die Setback - Negative mm	1.02	1.02	1.02
Secondary Air Velocity m/sec	30	30	30
Basis Weight g/m^2	52	44	6
Average Fiber Diameter μm	3.6	4.1	9.8

Web 1 was produced under conditions similar to those set forth in copending EP-A-86111123.5 for optimizing both barrier and strength properties in the final fabric. Web 2 was produced under modified conditions to produce a fabric with enhanced fabric strength, but with a slight loss of barrier properties, achieved by lowering the die temperature and the primary air velocity relative to web 1 conditions. Web 3 was produced by increasing the polymer throughput rate and further decreasing primary air velocity to produce a fiber layer having an average fiber diameter of 9.8 μm and in which 80% of the fibers have a fiber diameter greater than 7 μm.
Additionally the die temperature was raised to increase the initial interfiber bonding of Web 3. Table II lists the physical properties of embossed fabrics made from webs 1, 2 and 3. Table III sets forth the processing conditions for producing the embossed fabrics whose physical characteristics are listed on Table II.

TABLE II

DESCRIPTION AND PHYSICAL PROPERTY CHARACTERISTICS OF THERMALLY-EMBOSSED MELT-BLOWN NYLON

Characteristics	Fabrics 4	5	6	7
Composition - Layer 1	Web 1	Web 2	Web 3	Web 3
- Layer 2	-	-	Web 2	Web 2
- Layer 3	-	-	-	Web 3
Total Basis Weight (g/m^2)	52	44	50	56
Grab Tensile Strength to Weight Ratio ($N/g\text{-}m^{-2}$) MD	2.06	2.77	2.55	2.48
CD	1.53	1.94	1.95	1.90
Hydrostatic Pressure (cm of water)	49	36	39	39
Abrasion Resistance (cycles)				
Side 1 Dry - to pill	15	15	40	50
- to fail	100	100	100	100
Wet - to pill	15	15	30	35
- to fail	100	100	100	100
Side 2 Dry - to pill	15	15	15	50
- to fail	100	100	100	100
Wet - to pill	15	15	15	35
- to fail	100	100	100	100

TABLE III

PROCESS CONDITIONS FOR THERMAL EMBOSSING OF MELT-BLOWN NYLON

Process Conditions		Fabrics 4	5	6	7
Percent Embossed Area	(%)	18	18	18	18
Oil Temperature	(°C)				
Top Embossed Roll		126	122	121	121
Bottom Smooth Roll		126	122	122	122
Nip Pressure Between Rolls	(N/cm)	685	685	685	685
Web Speed	(m/min)	15	9	9	9

As noted in Table II, Fabric 5 shows superior grab tensile strength than Fabric 4, but decreased barrier properties as reflected in the hydrostatic pressure. The abrasion resistance remains the same. Fabrics 6 and 7 illustrate the improved abrasion resistance achieved with the use of surface veneers of web 3. Fabrics 6 and 7 show an increasing fall off of normalized grab tensile strengths due to the incorporation of the veneer layer(s) of web 3 which, while it adds to the weight of the fabric, it does not contribute as much grab tensile per unit weight as web 2. Veneer layers of web 3 add slightly to the hydrostatic head of Fabrics 6 and 7, but add remarkable surface abrasion resistance.

The dry surface abrasion resistance was measured as follows. A sample of the fabric to be tested was placed atop a foam pad on a bottom testing plate. A 7.6 cm by 12.7 cm sample of a standard Lytron finished abrading cloth was added to a top plate and placed in contact with the fabric test sample, with the machine direction of the fabric test sample aligned with the machine direction (length) of the Lytron finished cloth. A 1.1 Kg weight was placed atop the top plate and the bottom plate rotated at a fixed speed of 1.25 revolutions per minute, each rotation of the plate being recorded as one cycle. The fabric test sample was inspected under magnification after each of the first five cycles, and at five cycle intervals thereafter. The number of cycles to pill was recorded, as well as the number of cycles to create a hole in the fabric test sample. Pilling is defined as the breaking off of fibers which start of form clumps or beads. Four samples of the fabric were tested and the average number of cycles to pill and to fabric failure was reported.

The wet surface abrasion resistance was measured under a similar testing procedure, with the following modifications; the fabric test sample, fastened to the bottom plate was wetted with 5 drops or purified water, and only a 0.2 Kg weight was placed atop the top plate.

Example 2

In the following example webs 8, 9, 10, and 11 were produced under conditions set forth in Table IV below.

TABLE IV

PROCESS CONDITIONS USED TO PRODUCE MELT-BLOWN NYLON BASE WEBS				
Extruder Temperature - Feed °C Extruder Temperature - Exit °C	246 274	232 274	232 274	260 301
Process Conditions	Webs			
	8	9	10	11
Screen/Mixer Temperature °C	274	274	274	301
Die Temperature °C	274	265	265	301
Primary Air Temperature °C	309	285	285	331
Primary Air Velocity m/sec	299	252	191	299
Polymer Rate g/min-hole^{-1}	0.14	0.14	0.28	0.28
Die Air Gap mm	1.14	1.14	1.14	1.14
Die Setback - Negative mm	1.02	1.02	1.02	1.02
Secondary Air Velocity m/sec	30	30	30	0
Basis Weight g/m^2	52	42	6	6
Average Fiber Diameter µm			8.2	8.8

The process conditions for webs 8, 9, 10 and 11 fall within the process conditions set forth in copending EP-A-86111123.5. Web 8 was produced under conditions for optimizing both strength and barrier properties in the final fabric. Web 9 was produced under modified conditions to produce a fabric with enhanced fabric strength with a slight loss in barrier properties, by lowering the die temperature and primary air velocity relative to web 8 conditions. Web 10 was produced by increasing the polymer throughout rate and further decreasing the primary air velocity to produce a fiber layer having an average fiber diameter of approximately 9 µm, and in which 80% of the fibers have a fiber diameter greater than 7 µm.

The die temperature remained the same for webs 9 and 10. Web 11 was produced under conditions substantially similar to those for producing web 3 but with no secondary air so as to increase initial interfiber bonding. The die temperature for the production of web 11 was also increased over that used to produce web 10 to increase initial interfiber bonding.

Table V, below, lists the physical characteristics of embossed fabrics made from webs 8, 9, 10 and 11 under the conditions set forth in Table III. Fabric 13 comprises Fabric 12 with 3 g/m^2 of Primacor 4990, a 80/20 copolymer of ethylene and acrylic acid, manufactured by the Dow Chemical Company, added to each side of the fabric.

TABLE V

DESCRIPTION AND PHYSICAL PROPERTY CHARACTERISTICS OF THERMALLY-EMBOSSED MELT-BLOWN NYLON

Characteristics	Fabrics 12	13	14	15
Composition - Layer 1	Web 8	Binder	Web 10	Web 11
- Layer 2	-	Web 8	Web 9	Web 9
- Layer 3	-	Binder	Web 10	Web 11
Total Basis Weight (g/m^2)	52	58	54	54
Grab Tensile Strength (N)				
MD	94.1	103	94.0	108
CD	71.7	71.9	58.9	69.1
Hydrostatic Pressure (cm of water)	41	38	37	38

TABLE V
(Continued)

DESCRIPTION AND PHYSICAL PROPERTY CHARACTERISTICS OF THERMALLY-EMBOSSED MELT-BLOWN NYLON

Characteristics			Fabrics 12	13	14	15
Abrasion Resistance (cycles)						
Side 1	Dry	- to pill	5	15	40	45
		- to fail	100	100	100	100
	Wet	- to pill	5	15	30	40
		- to fail	100	100	100	100
Cusick Drape (%)			46	65	45	44

TABLE VI

PROCESS CONDITIONS FOR THERMAL EMBOSSING OF MELT-BLOWN NYLON WEBS

Process Conditions		Fabrics 12	14	15
Percent Embossed Area	(%)	18	18	18
Oil Temperature	(°C)			
Top Embossed Roll		104	106	93
Bottom Smooth Roll		97	99	95
Nip Pressure Between Rolls	(N/cm)	685	685	685
Web Speed	(m/min)	9	9	9

As shown in Table V, Fabric 13 shows an increase in surface abrasion resistance with a large increase in Cusick Drape. Further increases in binder level add-on will contribute to abrasion resistance but will continue to negatively impact the drape.

Fabric 14 exhibits far greater surface abrasion resistance than Fabric 13 with no attendant loss in drape. Fabric 15 exhibits an even greater improvement in surface abrasion resistance over that shown by Fabric 14. The increase is believed to be due to the increase in initial interfiber bonding of web 11.

Thus, it is apparent that there has been provided, in accordance with the invention, a new, unreinforced, melt-blown, microfiber fabric having enhanced surface abrasion resistance that satisfies the objects, aims and advantages set forth above. While the invention has been described in conjunction with specific embodiments thereof, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art in the light of the above description. Accordingly, it is intended to embrace all such

alternatives, modifications and variations that fall within the scope of the appended claims.

Claims

1. An abrasion resistant melt-blown microfiber fabric comprising a melt-blown microfiber core web and at least one melt-blown surface veneer of fibres having an average diameter in excess of 8 μm, 75% of which have a diameter of at least 7 μm, characterized in that at least one such veneer has a basis weight in the range 3-10 gm^{-2}.

2. A fabric according to Claim 1 which is embossed.

3. A fabric according to Claim 1 or Claim 2 in which the core web is thermally bonded at intermittent discrete bond regions to the said at least one such veneer.

4. A fabric according to Claim 3 in which the fabric is thermally embossed at intermediate discrete bond regions which occupy between 5 and 30% of the surface of the fabric.

5. A fabric according to any preceding Claim having a wet and dry abrasion resistance of greater than 30 cycles to pill.

6. A fabric according to any preceding Claim in which the said at least one such veneer consists of fibres having an average diameter of about 9 μm.

7. A fabric according to any preceding Claim in which the core web has a minimum grab tensile strength to weight ratio greater than 0.8 $Ng^{-1}m^2$ and a minimum Elmendorf tear strength to weight ratio greater than 0.04 $Ng^{-1}m^2$.

8. A fabric according to any preceding Claim in which the said at least one veneer has a wet and dry surface abrasion resistance of greater than 15 cycles to pill.

9. A fabric according to any preceding Claim in which the core web has a basis weight in the range 14-85 gm^{-2}.

10. A fabric according to any preceding Claim which has a wet and dry abrasion resistance of 30 and 40 cycles to pill respectively.

11. A fabric according to any preceding Claim which has a basis weight no greater than 60 gm^{-2}, a minimum grab tensile strength not lower than 65 N and a minimum Elmendorf tear strength not lower than 6 N.

12. A fabric according to any preceding Claim in which at least 80% of the fibres of the core web have a diameter less than or equal to 7 μm and the autogenous bonding of which fibres contributes no more than 30% of the strip tensile strength of the fabric.

13. A method of producing an abrasion resistant melt-blown microfibre fabric comprising forming a core web of melt-blown microfibres and forming a surface veneer of melt-blown fibres having an average diameter in excess of 8 μm, 75% of which have a diameter of at least 7 μm, characterised in that the veneer has a basis weight in the range 3-10 gm^{-2}.

14. A method according to Claim 13 wherein the fibres of the veneer have an average diameter of about 9 μm.

15. A method according to Claim 13 or 14 in which the veneer is formed with high initial autogenous bonding atop the core web.

16. A method according to Claim 13 or 14 in which the veneer is formed separately from the core web and is combined therewith to form a laminate.

17. A method according to Claim 16 including thermally embossing the laminate at discrete intermittent bond regions.

18. A method according to Claim 13 or 14 wherein a fibre-forming thermoplastic polymer resin in molten form is forced through a row of orifices (17) in a heated nozzle (13) into a stream of inert gas to attenuate the resin into fibres, the surface veneer is formed with good interfibre bonding by, at a first heated nozzle, maintaining the polymer melt temperature at a level which minimizes molecular degradation, controlling the primary air velocity, volume and temperature, polymer resin throughput and exit temperature to produce fibres having an average fibre diameter of greater than 8 µm, and in which 75% of the fibres have a fibre diameter of at least 7 µm and collecting the fibres on a receiver (22) at a forming distance, the core web is formed with low interfibre bonding by, at a second heated nozzle, maintaining the polymer melt temperature at a level which minimizes molecular degradation, controlling the primary air velocity, volume and temperature to produce fibres at least 80% of which have a diameter of 7 µm or less and having an average length of more than 10 centimetres, introducing a highly uniform high velocity secondary air stream in quantities sufficient to cool the fibres and maintain good fibre separation and collecting the fibres at a forming distance, and the fibres of the core web are collected on the surface veneer.

19. The method of Claim 18 further comprising producing fibres at a third heated nozzle and collecting those fibres on the exposed surface of the core web to form a second such surface veneer.

20. The method of Claim 18 or 19 further comprising thermally embossing the core web and the surface veneer or veneers.

Patentansprüche

1. Scheuerfester, im Schmelz-Blasform-Verfahren hergestellter Mikrofaser-(Vlies-)Stoff, umfassend eine im Schmelz-Blasform-Verfahren hergestellte Mikrofaserkernbahn und zumindest eine im Schmelz-Blasform-Verfahren hergestellte Oberflächenschicht aus Fasern mit einem Durchschnittsdurchmesser oberhalb von 8 µm, wobei 75% zumindest einen Durchmesser von 7 µm aufweisen, dadurch gekennzeichnet, daß zumindest eine solche Oberflächenschicht ein Flächengewicht im Bereich von 3-10 gm^{-2} aufweist.

2. (Vlies-)Stoff nach Anspruch 1, der geprägt ist.

3. (Vlies-)Stoff nach Anspruch 1 oder 2, bei dem die Kernbahn an einzelnen, unterbrochenen Bindebereichen mit der mindestens einen solchen Oberflächenschicht thermisch verbunden ist.

4. (Vlies-)Stoff nach Anspruch 3, bei dem der Stoff in einzelnen, unterbrochenen Bindebereichen thermisch geprägt ist, die zwischen 5 und 30% der Oberfläche des Stoffes einnehmen.

5. (Vlies-)Stoff nach einem der vorhergehenden Ansprüche, der eine Naß- und Trockenscheuerfestigkeit aufweist, die größer ist als 30 Umläufe bis zum Ablösen.

6. (Vlies-)Stoff nach einem der vorhergehenden Ansprüche, bei dem die zumindest eine Oberflächenschicht aus Fasern besteht, die einen Durchschnittsdurchmesser von etwa 9 µm aufweisen.

7. (Vlies-)Stoff nach einem der vorhergehenden Ansprüche, bei dem die Kernbahn ein minimales Verhältnis von Greifreißfestigkeit zu Gewicht von größer als 0,8 $Ng^{-1}m^2$ und ein Verhältnis von Elmendorf Einreißfestigkeit zu Gewicht von mindestens 0,04 $Ng^{-1}m^2$ aufweist.

8. (Vlies-)Stoff nach einem der vorhergehenden Anspüche, bei dem die zumindest eine Oberflächenschicht eine Naß- und Trockenscheuerfestigkeit von größer als 15 Umläufen bis zum Ablösen aufweist.

9. (Vlies-)Stoff nach einem der vorhergehenden Ansprüche, bei dem die Kernbahn ein Flächengewicht im Bereich von 14-85 gm^{-2} aufweist.

10. (Vlies-)Stoff nach einem der vorhergehenden Ansprüche, bei dem die Naß- und Trockenscheuerfestigkeit mindestens 30 bzw. 40 Umläufe bis zum Ablösen beträgt.

11. (Vlies-)Stoff nach einem der vorhergehenden Ansprüche, bei dem das Flächengewicht nicht größer als 60 gm^{-2}, eine minimale Greifreißfestigkeit nicht geringer als 65 N und eine minimale Elmendorf-Einreißfestigkeit nicht geringer als 6 N ist.

12. (Vlies-)Stoff nach einem der vorhergehenden Ansprüche, bei dem zumindest 80% der Fasern der Kernbahn einen Durchmesser von weniger oder gleich 7 µm aufweisen und die autogenen Bindungen der Fasern der Kernbahn nicht mehr als 30% zur Streifenreißfestigkeit des Stoffes beitragen.

13. Verfahren zum Herstellen eines scheuerfesten, im Schmelz-Blasform-Verfahren hergestellten Mikrofaserstoffes, umfassend das Formen einer Kernbahn aus im Schmelz-Blasform-Verfahren hergestellten Mikrofasern und das Formen einer Oberflächenschicht aus im Schmelz-Blasform-Verfahren hergestellten Fasern mit einem durchschnittlichen Durchmesser oberhalb von 8 µm, wobei 75% der Fasern einen Durchmesser von zumindest 7 µm aufweisen, dadurch gekennzeichnet, daß die Oberflächenschicht ein Flächengewicht im Bereich von 3-10 gm^{-2} aufweist.

14. Verfahren nach Anspruch 13, bei dem die Fasern der Oberflächenschicht einen durchschnittlichen Durchmesser von etwa 9 µm aufweisen.

15. Verfahren nach einem der Ansprüche 13 oder 14, bei dem die Oberflächenschicht mit hohen, anfänglichen autogenen Bindungen auf der Kernbahn gebildet wird.

16. Verfahren nach Anspruch 13 oder 14, bei dem die Oberflächenschicht getrennt von der Kernbahn hergestellt wird und mit dieser kombiniert wird, um ein Laminat zu bilden.

17. Verfahren nach Anspruch 16, umfassend den Verfahrensschritt das Laminat an einzelnen, unterbrochenen Bindebereichen thermisch zu prägen.

18. Verfahren nach Anspruch 13 oder 14, bei dem ein faserformendes, thermoplastisches Polymerharz in geschmolzenem Zustand durch eine Reihe von Öffnungen (17) in einer beheizten Düse (13) in einen Strom eines Inertgases gedrückt wird, um das Harz zu Fasern zu verdünnen, bei dem die Oberflächenschicht mit einer guten Zwischenfaserbindung hergestellt wird, indem die Polymerschmelztemperatur an einer ersten beheizten Düse auf einem Niveau gehalten wird, das die molekulare Zersetzung minimiert, indem die Geschwindigkeit, das Volumen und die Temperatur der Primärluft sowie der Polymerharzdurchsatz und die Austrittstemperatur geregelt werden, um Fasern herzustellen, die einen Durchschnittsfaserdurchmesser von größer als 8 µm aufweisen, und bei denen 75% der Fasern einen Faserdurchmesser von mindestens 7 µm aufweisen, und Sammeln der Fasern auf einem Sammelkasten (22) in einem Formabstand, bei dem die Kernbahn mit geringer Bindung zwischen den Fasern hergestellt wird, indem die Polymerschmelztemperatur an einer zweiten beheizten Düse auf einem Niveau gehalten wird, das die molekulare Zersetzung minimiert, und indem die Geschwindigkeit, das Volumen und die Temperatur der Primärluft geregelt werden, um Fasern zu produzieren, bei denen zumindest 80% einen Duchmesser von 7 µm oder weniger aufweisen und die eine Durchschnittslänge von mehr als 10 cm haben, indem ein sehr ebenmäßiger und gleichförmiger Hochgeschwindigkeitsstom von Sekundärluft zugeführt wird, dessen Menge ausreicht, um die Fasern abzukühlen und eine gute Fasertrennung sicherzustellen und die Fasern in einem Formabstand zu sammeln, und bei dem die Fasern der Kernbahn auf der Oberflächenschicht gesammelt werden.

19. Verfahren nach Anspruch 18, weiter umfassend den Verfahrensschritt, Fasern in einer dritten, beheizten Düse herzustellen und diese Fasern auf der freiliegenden Oberfläche der Kernbahn zu sammeln, um eine zweite Oberflächenschicht zu bilden.

20. Verfahren nach Anspruch 18 oder 19, weiter umfassend den Verfahrensschritt, die Kernbahn und die Oberflächenschicht oder Oberflächenschichten thermisch zu prägen.

Revendications

1. Etoffe de microfibres de fondu-soufflé résistante à l'abrasion comprenant une bande d'âme de microfibres de fondu-soufflé et au moins un placage de surface de fondu-soufflé en fibres ayant un diamètre moyen de plus de 8 μm, dont 75% ont un diamètre d'au moins 7 μm, caractérisée en ce que au moins un tel placage possède un poids de base situé dans l'intervalle de 3 à 10 gm^{-2}.

2. Etoffe selon la revendication qui est emboutie.

3. Etoffe selon la revendication 1 ou la revendication 2 dans laquelle la bande d'âme est reliée thermiquement par intervalles en des régions de liaison discrètes audit tel placage.

4. Etoffe selon la revendication 3 dans laquelle l'étoffe est emboutie thermiquement en des régions de liaison discrètes intermédiaires qui occupent entre 5 et 30% de la surface de l'étoffe.

5. Etoffe selon l'une quelconque des revendications précédentes ayant une résistance à l'abrasion humide et sèche qui dépasse 30 cycles pour le boulochage.

6. Etoffe selon l'une quelconque des revendications précédentes dans laquelle ledit tel placage est composé de fibres ayant un diamètre moyen d'environ 9 μm.

7. Etoffe selon l'une quelconque des revendications précédentes dans laquelle la bande d'âme possède un ratio minimum par unité de poids de résistance à l'essai d'arrachement par traction qui dépasse 0,8 $Ng^{-1}m^2$ et un ratio minimum par unité de poids de résistance à l'essai de déchirage Elmendorf qui dépasse 0,04 $Ng^{-1}m^2$.

8. Etoffe selon l'une quelconque des revendications précédentes dans laquelle ledit placage possède une résistance à l'abrasion de surface humide et sèche qui dépasse 15 cycles pour le boulochage.

9. Etoffe selon l'une quelconque des revendications précédentes dans laquelle la bande d'âme possède un poids de base situé dans l'intervalle de 14 à 85 g/m^2.

10. Etoffe selon l'une quelconque des revendications précédentes, qui possède une résistance à l'abrasion humide et sèche de 30 et 40 cycles pour le boulochage respectivement.

11. Etoffe selon l'une quelconque des revendications précédentes, qui possède un poids de base ne dépassant pas 60 g/m^2, une résistance minimum à l'essai d'arrachement par traction non inférieure à 65 N et une résistance minimum à l'essai de déchirage Elmendorf non inférieure à 6 N.

12. Etoffe selon l'une quelconque des revendications précédentes dans laquelle au moins 80% des fibres de la bande d'âme ont un diamètre inférieur ou égal à 7 μm, la liaison autogène de ces fibres ne contribuant pas à plus de 30% de la résistance à la rupture par traction de l'étoffe.

13. Procédé de fabrication d'une étoffe de microfibres de fondu-soufflé résistante à l'abrasion comprenant les étapes consistant à former une bande d'âme de microfibres de fondu-soufflé et à former un placage de surface de fibres de fondu-soufflé ayant un diamètre moyen de plus de 8 μm, dont 75% ont un diamètre d'au moins 7 μm, caractérisé en ce que le placage possède un poids de base situé dans l'intervalle de 3 à 10 g/m^2.

14. Procédé selon la revendication 13 dans lequel les fibres de placage ont un diamètre moyen de 9 μm environ.

15. Procédé selon la revendication 13 ou 14 dans lequel le placage est formé avec une liaison autogène initiale élevée au-dessus de la bande d'âme.

16. Procédé selon la revendication 13 ou 14 dans lequel le placage est formé séparément de la bande d'âme et est combiné avec celle-ci pour former un lamifié.

17. Procédé selon la revendication 16 comportant un emboutissage thermique lamifié en des régions de liaison discrètes par intervalles.

18. Procédé selon la revendication 13 ou 14 dans lequel on force une résine de polymère thermoplastique sous forme fondue à passer à travers une rangée d'orifices (17) d'une filière chauffée (13) dans un courant de gaz inerte pour effiler la résine en fibres, le placage de surface est formé avec une bonne liaison interfibre, à une première filière chauffée, en maintenant la température du bain fondu de polymère à un niveau qui minimise la dégradation moléculaire, en réglant la vitesse, le volume et la température de l'air primaire, le débit de passage de la résine de polymère et la température de sortie pour produire des fibres ayant un diamètre moyen de plus de 8 µm, et dans lesquelles 75% des fibres ont un diamètre de fibre d'au moins 7 µm et en recueillant les fibres sur un récepteur (22) à une distance de formation, la bande d'âme est formée avec une faible liaison interfibre, à une seconde filière chauffée, en maintenant la température du bain fondu de polymère à un niveau qui minimise la dégradation moléculaire, en réglant la vitesse, le volume et la température de l'air primaire pour produire des fibres dont au moins 80% ont un diamètre de 7 µm ou moins et ayant une longueur moyenne de plus de 10 cm, en introduisant un courant d'air secondaire très rapide hautement uniforme en quantité suffisante pour refroidir les fibres et maintenir une bonne séparation de fibres et en recueillant les fibres à une distance de formation, et les fibres de la bande d'âme sont recueillies sur le placage de surface.

19. Procédé selon la revendication 18 comprenant en outre la production de fibres à une troisième filière chauffée et le recueil de ces fibres sur la surface exposée de la bande d'âme pour former un second tel placage de surface.

20. Procédé de la revendication 18 ou 19 comprenant en outre l'emboutissage thermique de la bande d'âme et du placage ou des placages de surface.

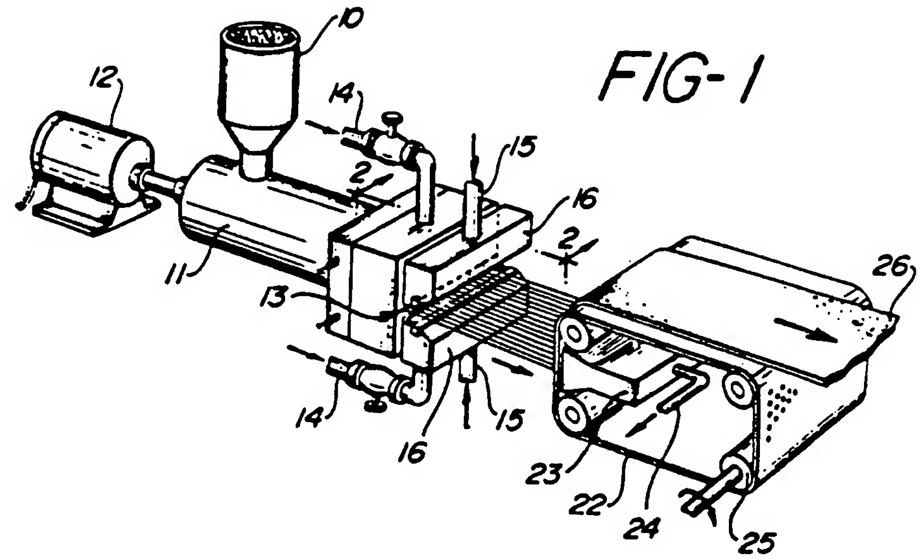

FIG-1

FIG-2

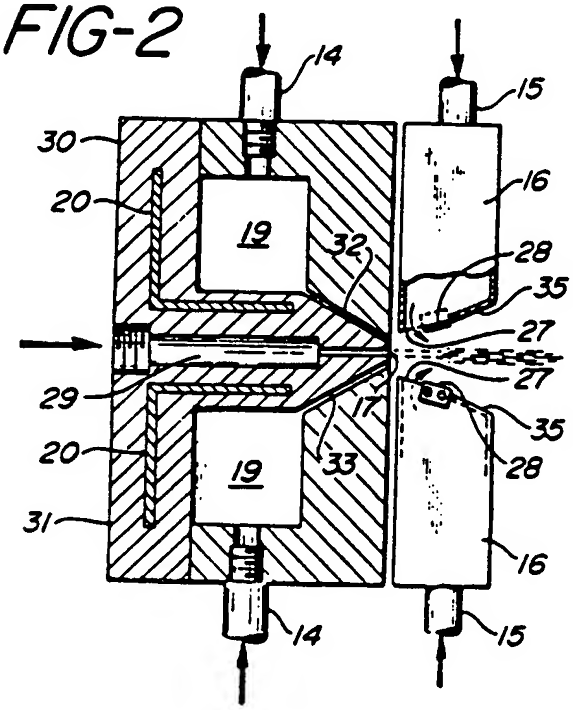

FIG-3

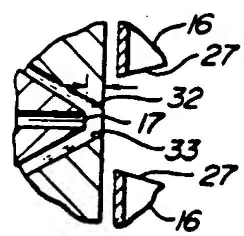

FIG-4